15. — *The Physiology of Man; designed to represent the existing State of Physiological Science as applied to the Functions of the Human Body.* By Austin Flint, Jr., M. D. New York: D. Appleton & Co. 1866. 8vo. pp. 502.

This is the first of a series of three volumes, and treats of the subjects Blood Circulation and Respiration. The author is a young, zealous, and successful worker, who has earned a high reputation, not only as a teacher, but through his own original investigations and valuable contributions to human physiology. He is a disciple of the experimental school; and the conclusion which inevitably forces itself upon the mind of the reader of his book is, that precise knowledge of the uses of parts can only be obtained by the careful study of them in the living body, and, however much one might wish it were otherwise, often through the vivisection of animals. The physicist studies matter in the states of rest and motion, and knows that, however complete his knowledge of it in the first may be, it will throw no light on the laws and phenomena manifested in the second. Any knowledge of the properties of matter in itself would never enable him to foresee what would happen if it were moving in a resisting medium or in the neighborhood of another mass. So in the investigation of organized beings, the study of structure, composition, form, and relative position of their different parts in a state of rest, as dead bodies, or, in other words, the study of anatomy, has never been able to teach the changes and actions of which these parts might be the seat during life. Anatomy never pointed out the distinction between the nerves of motion and sensation, nor could any one, on anatomical grounds, assert that a lung was intended to be the medium of a physical interchange between the atmosphere and the blood. There are organs, like the spleen, the thymus, and thyroid bodies, and certain portions of the brain, the structure of which is now as well known as that of other parts, but we still remain profoundly ignorant of their uses. These can only be determined, if at all, by following the example of Harvey, and by "frequent appeals to vivisection and constant ocular inspection, investigation, and endeavor to find the truth."

The knowledge of the physiologist comes in various ways, through the aid of the knife, the microscope, the battery, the balance, and the test-tube; but with these the necessity for experiment on living animals, though not in all cases by vivisection, is absolute, for all the best results from Harvey to the present time have come through such means. Those who preceded Harvey knew the structure of the heart, the arteries, the veins, and even the circulation of the lungs; but the knowledge

was barren, until, by direct experiment on the vessels, such as tying the arteries and veins in the living body, and noticing on which side of the cord the blood accumulated, and by watching the motions of the heart in its natural position, "employing for these experiments a great variety of animals," he at length demonstrated the course in which the blood flowed. The attempts to determine the force of the heart's action were utter and often ludicrous failures so long as they were based on mere calculation, or the analogies of other muscular parts. Borelli, comparing the weight of the heart with that of the deltoid, estimated its force at many thousand pounds; while Kiell, studying the rate of the flow of blood through the arteries, computed it at five ounces. Hales, with the sagacity of the true observer, simply inserted a tube into one of the larger arteries of a living animal, noted the height of the column which the heart sustained, and thus its force was weighed. One might fill a volume in recording similar contrasts of success and failure, according as the investigations were conducted with and without experiment. The results of the experimental method are the living truths of science. Great and learned as he was, the speculations of Boerhaave on digestion have passed from the current literature of physiology; while the experiments of Réaumur and Spallanzani will never fail to receive honorable mention. Without vivisections there is no reason to suppose that we should have had the benefit of the discoveries of Bell or of Bernard, and others of the same school, and without these physiology would not deserve the name of a science. With ether and chloroform at the disposal of the physiologist, vivisection is stripped of its horrors; nevertheless, whoever resorts to it assumes a fearful responsibility, and can only justify himself by an honest conviction of his fitness for the work through mental aptitude and adequate preparatory study. It is perhaps too true that physiologists use it with reckless freedom; it belongs almost wholly to the laboratory, and its introduction into the lecture-room for trivial experiments cannot be too severely condemned.

In view of the extent to which the division of labor is now carried in physiological investigations, a work like the one we are now noticing must be, from the necessities of the case, chiefly a compilation. In general this work is clearly written, and the materials pertaining to the special subjects are methodically arranged; but the absence of anything like a general classification of the functions in the order of their relations to each other is a defect. A living being has been compared by Cuvier to a vortex, but by others, and with more reason, to a flame, which is a vortex and something more. The oil and the oxygen of the air form the ingoing currents, and during their short stay undergo a new

molecular arrangement, and at the same time give rise to the sensible phenomena of light and heat; as an outgoing current they escape in the form of carbonic acid and water. In the living body there are two analogous currents, the first composed of the materials of the food, the second of those of the excretions; and in the passage of nutritive material from one to the other, heat and nervous and muscular force are evolved. The functions of nutrition and excretion form two entirely distinct groups, one balancing the other; and the order of their arrangement obviously should be that in which they stand with reference to the passage of food and its products through the body; namely, for the nutritive, digestion, absorption, circulation, assimilation; and for the excretory, the functions of the lungs, skin, and kidneys.

One cannot read a work like this without being forcibly struck with the fact that certain questions still remain open which it seems ought long since to have been decided. Since the days of Harvey it has been a matter of dispute whether the heart lengthens or shortens during its contraction or systole. The experiments tried by Dr. Flint seem to us conclusive in favor of the opinion that it shortens, and they agree with the results of our own observations repeated many times. But Dr. Dalton, whose skill and accuracy as an observer are of the highest order, maintains exactly the opposite view, based on repeated experiments. There is another question, namely, that relating to the origin of the blood corpuscles, which the author disposes of in a manner altogether too summary. Since good observers have traced them in the embryo to the direct transformation of the central cells of the heart and vessels, while these are yet in the formative stage, he is hardly justified in asserting that "it is the most reasonable to consider that the red globules are formed by a true *genesis* in the sanguineous blastema," that is, in the strictly fluid portion of the blood, without adducing a single fact in support of his opinion. His view of the reproduction of them in the adult after large hemorrhages is equally unsupported by evidence.

Notwithstanding these and other matters which are open to criticism, the work as a whole deserves to be spoken of in terms of high praise. The introductory chapter treats fully of the chemistry of the proximate principles, and the physiological account of each of the organs is preceded by a clear and concise anatomical description, and in a few instances the descriptions are illustrated by diagrams. These ought to have been more extensively used. The experimental evidence is drawn largely from the current literature of the subject, and is freely and fairly introduced.

Among the recent additions to the means of physiological investiga-

tion, the sphygmograph, or pulse-marker, of Marey is the most noteworthy. This instrument not only indicates, but registers on a card, "the form of the pulse," and thus shows many varieties of it which the touch fails to recognize. The essential part of the instrument is a lever, the end of the short arm of which is pressed upon the artery, and that of the other, which carries a point, presses against a card that is made to slide steadily past it. As the artery fills and empties, the lever rises and falls, and thus traces its movements. The result of experiments with this instrument, and of Marey's other experiments in the passage of fluids through elastic tubes imitating the vascular system, are among the most valuable of the recent contributions to the physiology of the circulation of the blood.

---

16. — *Mind in Nature; or the Origin of Life, and the Mode of Development of Animals.* By HENRY JAMES CLARK, A. B., B. S. With over Two Hundred Illustrations. New York: D. Appleton & Co. 1865. 8vo. pp. 322.

THIS work comprises the substance of a course of lectures delivered before the Lowell Institute in 1864, and relates chiefly to three subjects, — the origin of life, the great divisions of the animal kingdom, and the conformity of animals in their mode of development to the type of the divisions to which each animal belongs.

In admitting five grand divisions instead of four, Professor Clark follows the lead of many naturalists who have found it otherwise impossible to dispose of a portion of the Infusoria. Cuvier left these a heterogeneous mass among the Radiates. Ehrenberg threw a flood of light on their structure, and but little on their zoölogical relations. Many of them have since been shown to be plants, others embryos, and still others have been referred to one or the other of the types of Invertebrates. Agassiz believes that all will in this way be eventually distributed. But as it now stands, a portion still remain which cannot be referred to either of the categories just mentioned, and are therefore regarded as forming the grand division to which the term Protozoa has been applied, and of which Professor Clark finds a characteristic feature in the spiral type of structure. Before this can be admitted as anything more than a provisional arrangement, these organisms require a much more complete investigation than they have yet received, and we know of no one better prepared for the work than Professor Clark himself. The chapter on the third head mentioned above agrees in principle with views already adopted by others; and